(12) UK Patent Application (19) GB (11) 2 290 631 (13) A

(43) Date of A Publication 03.01.1996

(21) Application No 9511351.0

(22) Date of Filing 05.06.1995

(30) Priority Data
(31) 06143594 (32) 24.06.1994 (33) JP
06143595 24.06.1994

(51) INT CL[6]
G01M 15/00 , G05B 23/02

(52) UK CL (Edition O)
G3N NGK1 N286C N288A N381 N387 N402A N403 N404
U1S S1820 S1990 S1991

(56) Documents Cited
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US 4821217 A

(58) Field of Search
UK CL (Edition N) G3N NGK1 NGK2 NGL
INT CL[6] G01M 15/00 17/00 , G05B 23/02
ONLINE : WPI

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(54) Diagnosis system for motor vehicle

(57) A portable type diagnosing apparatus A reads data from an electronic control unit D of a vehicle and sends the data to an external computer B by wire-less connection 70. The external computer conducts miscellaneous calculations based on the data and displays the result of the calculations on a display 52 of the external computer or analyses failures of the vehicle in a running state. Further, when service manuals are needed, according to a command from the portable type diagnosing apparatus A, they are sent from the external computer B and displayed on a display 36 of the portable type diagnosing apparatus A.

FIG. 1

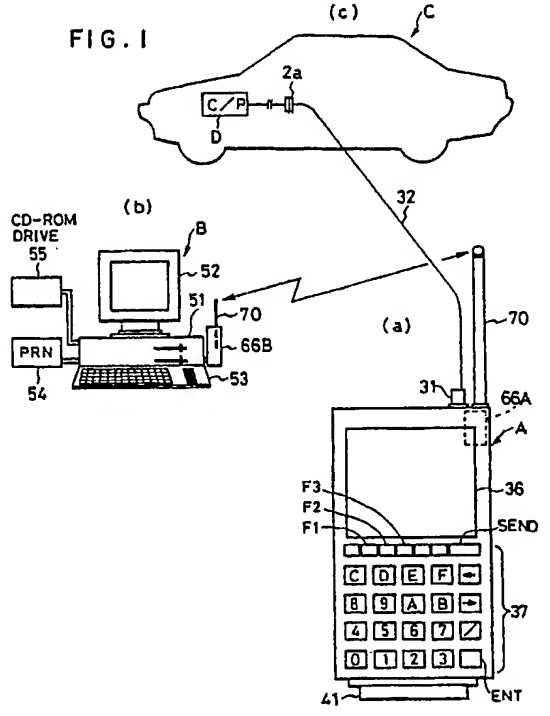

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FIG. 2A

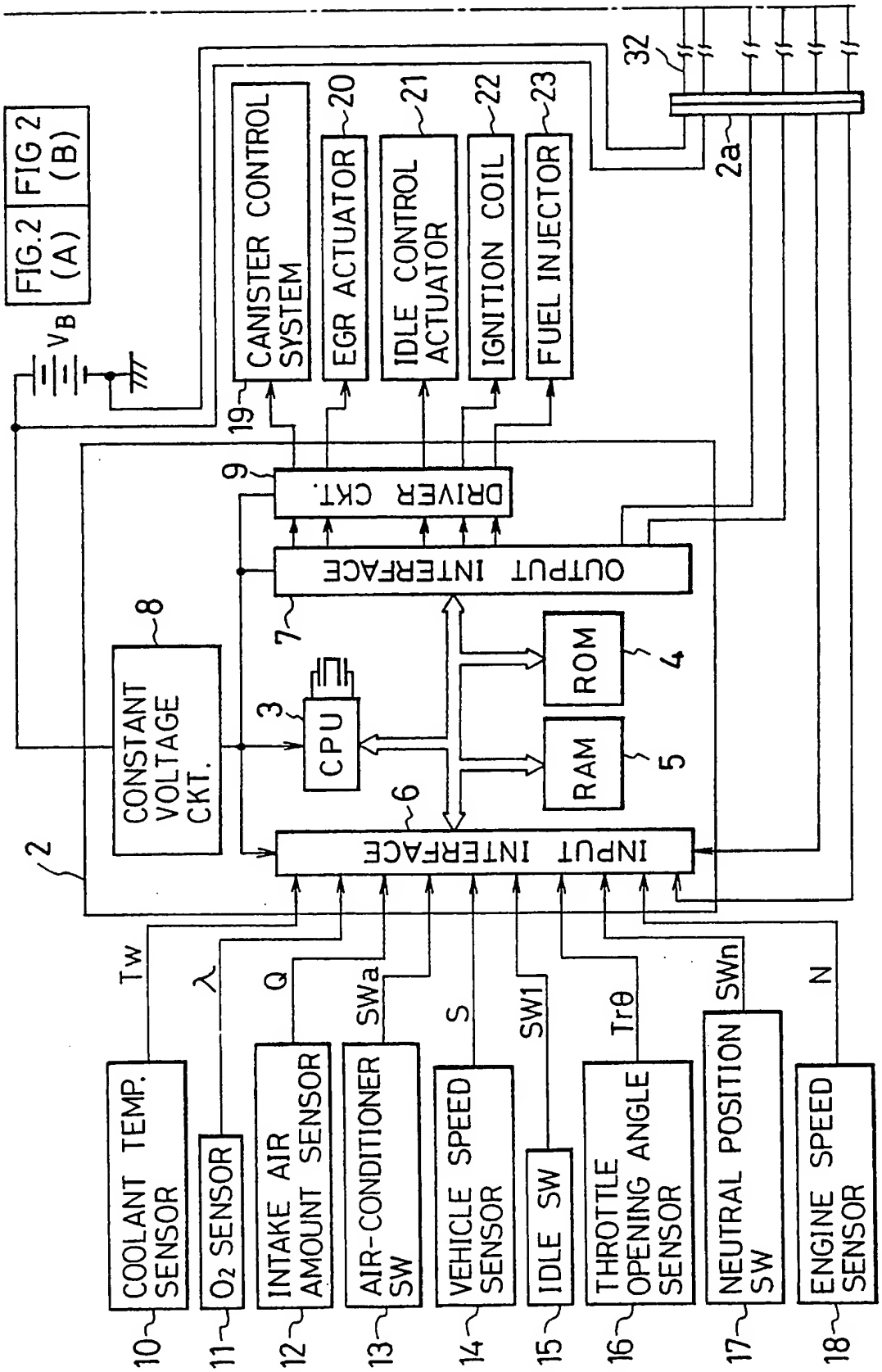


FIG.2 (A)
FIG 2 (B)
V_B
CANISTER CONTROL SYSTEM
EGR ACTUATOR
IDLE CONTROL ACTUATOR
IGNITION COIL
FUEL INJECTOR
19
20
21
22
23
32
2a
DRIVER CKT.
9
OUTPUT INTERFACE
7
8
CONSTANT VOLTAGE CKT.
CPU
3
ROM
4
RAM
5
6
INPUT INTERFACE
2
Tw
λ
Q
SWa
S
SW1
Trθ
SWn
N
COOLANT TEMP. SENSOR
O_2 SENSOR
INTAKE AIR AMOUNT SENSOR
AIR-CONDITIONER SW
VEHICLE SPEED SENSOR
IDLE SW
THROTTLE OPENING ANGLE SENSOR
NEUTRAL POSITION SW
ENGINE SPEED SENSOR
10
11
12
13
14
15
16
17
18

FIG. 3

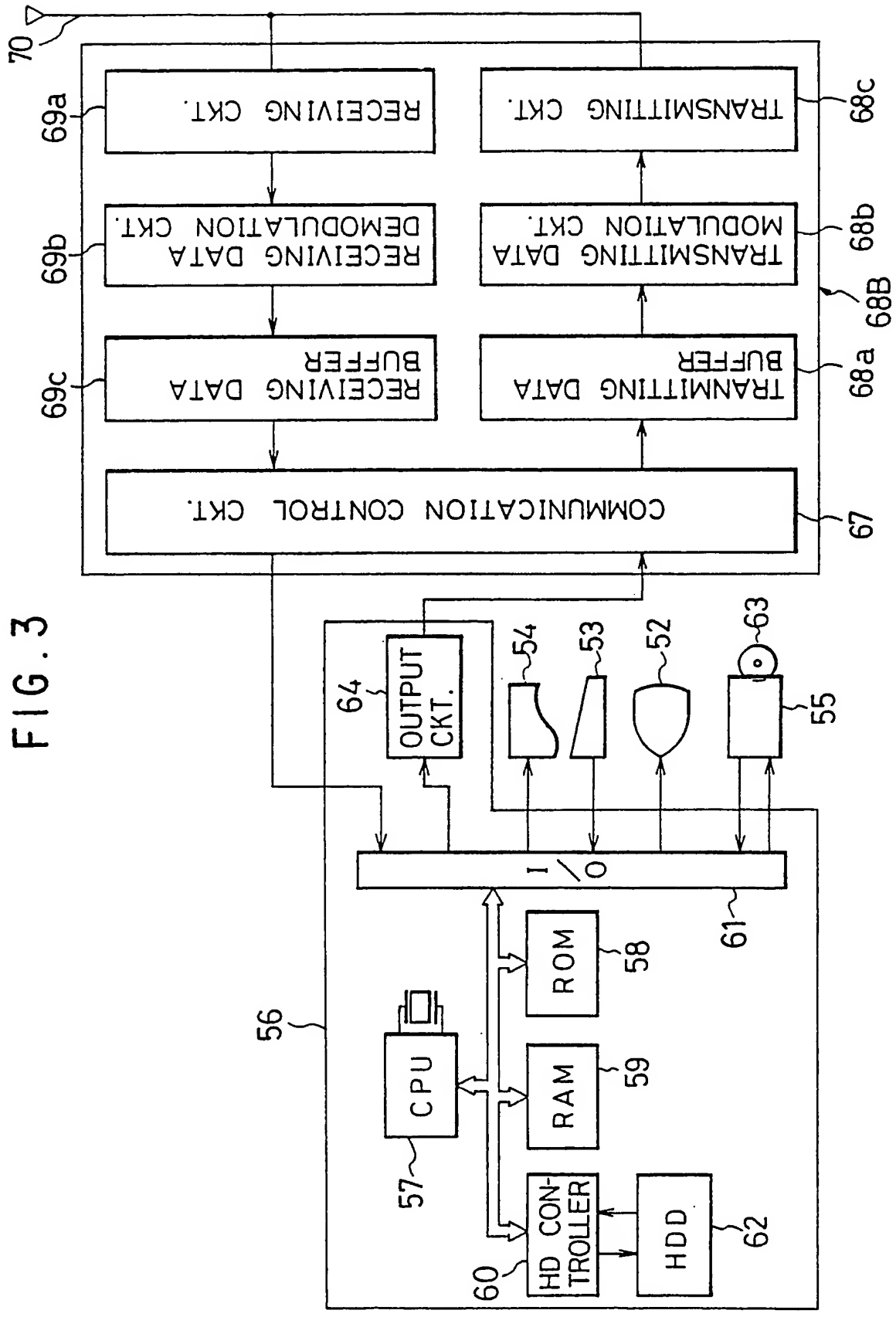

70
69a
RECEIVING CKT.
68c
TRANSMITTING CKT.
69b
RECEIVING DATA DEMODULATION CKT.
TRANSMITTING DATA MODULATION CKT.
68b
68B
69c
RECEIVING DATA BUFFER
TRANMITTING DATA BUFFER
68a
COMMUNICATION CONTROL CKT.
67
64
OUTPUT CKT.
54
53
52
63
55
I/O
61
56
ROM
58
CPU
RAM
59
57
HD CONTROLLER
HDD
62
60

FIG. 5

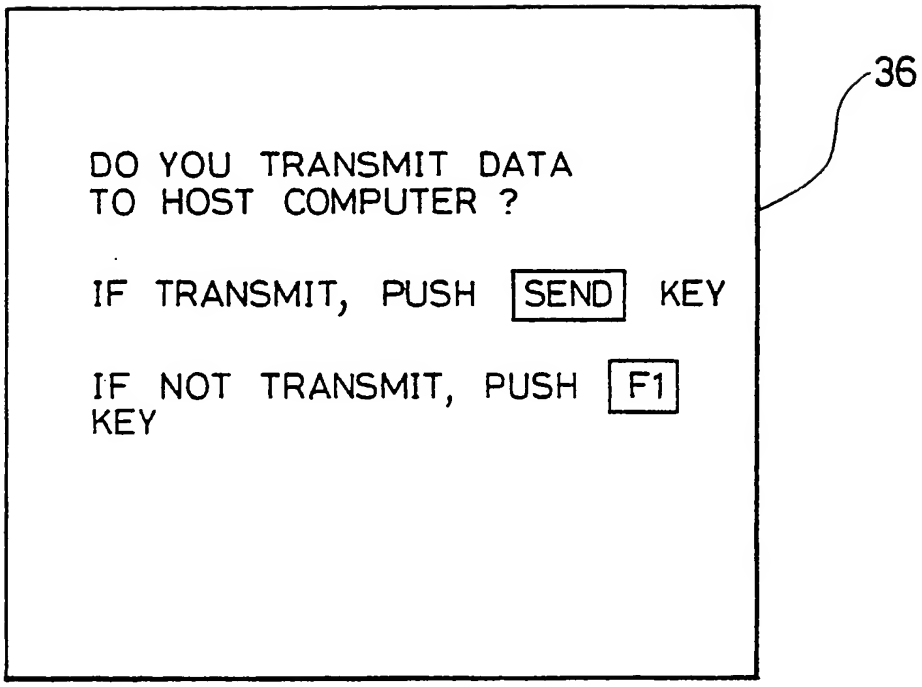
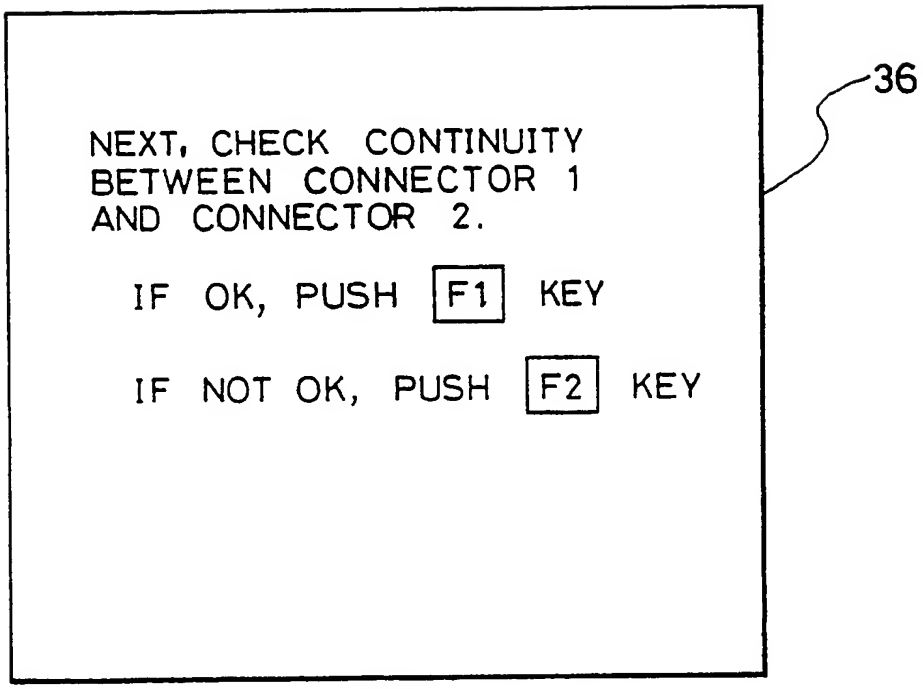

36
DO YOU TRANSMIT DATA
TO HOST COMPUTER ?
IF TRANSMIT, PUSH SEND KEY
IF NOT TRANSMIT, PUSH F1
KEY

FIG. 7


NEXT, CHECK CONTINUITY
BETWEEN CONNECTOR 1
AND CONNECTOR 2.
IF OK, PUSH F1 KEY
IF NOT OK, PUSH F2 KEY
36

unable to be processed by the apparatus to the external computer for processing.

However, the diagnostic system according to this prior art has a disadvantage in that it is inconvenient to handle the system because it needs a cable communicating the portable type diagnosing apparatus with the external computer. That is, a service mechanic must connect a cable between a workplace where the diagnosing apparatus is located and a station where the computer is located. This may bring troubles or inconvenience during servicing in the workplace.

Furthermore, generally in diagnosing the vehicle, diagnoses are frequently performed during the running of the vehicle in order to confirm faults by reproducing them in actual use. In this case, the above mentioned diagnosis system is almost of no use because of the existence of the cable connecting the diagnosing apparatus and the external computer.

Next, when the service mechanic attempts to check the control system of the vehicle, he has to proceed diagnoses in accordance with a service manual. In this case, the service manual should be located near the service mechanic, because, while referring to the service manual, he must compare the miscellaneous data acquired through the diagnosing apparatus with the data or specifications described in the service manual to check an existence or non-existence of a fault and to identify where faults are located.

Some recent diagnosing apparatuses can display the

the known diagnostic systems.

According to a first aspect of the invention a diagnostic system for diagnosing the operation of an electronic control circuit on a motor vehicle, said system comprises diagnostic apparatus, conductive connecting means connecting the diagnostic apparatus and the electronic control circuit and an external computer, said diagnostic apparatus having data reading means for reading data received from the control unit via the conductive connecting means, first data display means for displaying said data and transmitting means for transmitting data by a wire-less link; said external computer having means for receiving data transmitted by a wire-less link, data processing means for processing data and outputting data and second data display means for displaying data.

The diagnostic system further comprises: data requiring command inputting means for inputting a data requiring command to the portable diagnosing apparatus; first wire-less data transmitting means provided in the portable diagnosing apparatus for transmitting the command by wire-less link; second wire-less data receiving means provided in the external computer for receiving the command; a data storing medium provided in the external computer for storing service data; retrieving means provided in the external computer for retrieving the service data from the data storing medium based on the command and outputting the service data; second wire-less data transmitting means provided in the external computer for transmitting the service data; first wire-less data receiving means provided

receiving at an external computer said data transmitted by the wire-less link, processing said data and displaying outputted data at said computer.

A specific embodiment of the present invention will be described, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic diagram showing a diagnosis system according to the present invention;

Fig. 2 is a block diagram showing the relationship between a diagnosing apparatus and an electronic control unit of a vehicle according to the present invention;

Fig. 3 is a block diagram in a host computer according to the present invention;

Fig. 4 is a flowchart showing a data communication process according to the present invention;

Fig. 5 is a drawing showing an example of a message to be displayed on the portable type diagnosing apparatus;

Fig. 6 is a flowchart showing a data communication process according to another embodiment of the present invention; and

Fig. 7 is a drawing showing an example of a message to be displayed on the portable type diagnosing apparatus according to another embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to Fig. 1, the diagnosis system according to the present invention comprises a portable type diagnosing apparatus (a so-called hand-held computer) A and host computer B. This diagnosis system is employed in service shop to diagnose an electronic control unit D in

corresponding to these control variables are outputted from the output interface 7 to the driver circuit 9 at a specified timing. Then, these control signals are transformed into driver signals in the driver circuit 9. Then these driver signals are outputted to a canister control system 19, an EGR actuator 20 for controlling an EGR amount, an idling control actuator 21 for controlling an idling speed, an ignition coil 22 for energising an ignition signal on a spark plug, a fuel injector 23 for metering and injecting a specified amount of fuel and other device to control the engine at an optimum condition in any operational area.

Next, the portable type diagnosing apparatus A will be described.

The portable type diagnosing apparatus A has a display 36 and a key board 37. Further, inside the apparatus, a diagnosis control section 38 composed of a CPU 42, a RAM 43, an I/O (input and output) interface 44, a busline through which these are connected with each other and an output circuit 45, and an electric power source circuit 39 are disposed as shown in Fig. 2.

Further, the diagnosis control section 38 is connected to a ROM cartridge 41 through a connector 40 for the purpose of a wide use, i.e., various diagnosis items and different vehicle models. The ROM cartridge 41 contains a ROM 41a wherein diagnosis items and diagnosis programs for different vehicle models are memorised.

Further, diagnosis mode signals which are inputted from the key board 37 enter into an input port of the I/O

communication by a wire-less link such as radio transmission. As shown in Fig. 2 and Fig. 3, the output port of the I/O interface 44, 61 of the control section 38, 56 is respectively connected with an output circuit 45, 64 for outputting the data processed in the control section 38, 56 to the data communication unit 66A, 66B respectively. Further, the receiving data from the communication unit 66A, 66B are inputted to the input port of the I/O interface 44, 61 respectively.

On the other hand, the data communication unit 66A, 66B respectively comprise a communication control circuit 67, 67 for sending and receiving the data between the data communication unit 66A and 66B, a transmitting data buffer 68a, 68a for storing the transmitting data outputted from the communication control circuit 67 temporarily, a transmitting data modulation circuit 68b, 68b for modulating the transmitting data into signals fit for the data transmission and a transmitting circuit 68c, 68c for transmitting the modulated transmitting data to the data communication unit 66A, 668 respectively through an antenna 70, 70 by radio, a receiving circuit 69a for receiving the transmitting data through the antenna 70, 70, a receiving data demodulation circuit 69b for demodulating this receiving data into signals fit for the processing in the control section 38, 56 and a receiving data buffer 69c, 69c for storing the demodulated receiving data temporarily.

Next, an exemplary procedure for communicating between the engine control unit 2, the portable type diagnosing apparatus A and the host computer B will be described

processes such as a transformation into physical quantity. Then, at a step S4 those processed data are displayed on the display 36 of the diagnosing apparatus A. For example, in case of the fuel injection pulse width, a fuel injection pulse duration time is displayed in figures on the display 36.

Next, at a step S5 it is judged whether or not those data should be sent to the host computer B. In this embodiment, for example, such a message as shown in Fig. 5 appears on the display 36. If the mechanic wants to send, he pushes a (SEND) key and if does not he pushes a (F1) key. In case of pushing the (F1) key, the data are not sent and accordingly the program returns to the step S1. In case of pushing the (SEND) key, the program goes to a step S6 where the data are sent to the host computer B and after that the program returns to the step S1.

Returning to the step S1, the command already inputted is executed automatically and therefore updated information is always displayed on the display 36 of the diagnosing apparatus A. Further, while the sending command is outputted to the host computer B, the data are continued to be sent to the host computer B in time series. When a new command is inputted or a resetting operation is made, the data sending from the diagnosing apparatus A to the host computer B is also reset.

In the diagnosing apparatus A, the data to be sent are outputted from the output circuit 45 of the diagnosis control section 38 to the communication control circuit 67 of the data communication unit 66A. The data are stored in

and therefore cables do not hamper the movement of people in the workshop. Further, in this wire-less diagnosis system, since plural diagnosing apparatuses A can be operated simultaneously per one host computer B, work efficiency is largely improved.

In the first embodiment described before, the data transmission is performed only from the portable type diagnosing apparatus A to the host computer B.

In a second embodiment mentioned hereinafter, a diagnosis system capable of communicating mutually between the diagnosing apparatus and the host computer will be described. Following explanation is an example of the processes to be taken in the second embodiment according to the present invention,

The service mechanic connects the portable type diagnosing apparatus A with the engine control unit 2 through the adapter harness 32. Referring to Fig. 6, when a switch (not shown) is turned on, at a step S31 it is judged whether or not the data are required to the engine control unit 2. At this moment, a message showing whether or not the data are required to the engine control unit 2 is displayed on the display 36 of the diagnosing apparatus A. He inputs a command (a [1] key if required and a [0] key if not required).

If "data required" is chosen, the program goes to a step S32 where the command corresponding to the kind of data is inputted through the keyboard 37. For example, in case where the data of the fuel injection pulse duration time (fuel injection pulse width) are needed, he inputs F1 2 ENT.

information required here includes a service manual, a service bulletin, a parts list and other information associated with service works. In this case a message whether or not a service manual is required is indicated on the display 36. The mechanic inputs a command (a [1] key if required and a [0] key if not required) according to the message.

In a case where it is judged that the service manual is not required, the program returns to the step S31 in which a new command waits for being inputted. On the other hand, in a case where it is judged that a service manual is required, the program goes to a step S36 where a command requiring the service manual is inputted through the keyboard 37 and the command is sent to the host computer B by wireless after being converted into a service manual requirement code. At the next step S37 the program waits for the service manual being sent from the host computer B.

The service manual requirement code is sent from the output circuit 45 of the diagnosis control section 38 to the communication control circuit 67 of the data communication unit 66A and stored in the transmission data buffer 68a temporarily. After this requirement code is modulated into a signal fit for the data transmission in the transmission data modulation circuit 68b, it is sent from the transmission circuit 68c by wire-less link through the antenna 70.

This data sent by wire-less link is received by the receiving circuit 69a of the data communication unit 66B in the host computer B through the antenna 70 and is stored

Further, in the diagnosis control section 38 of the portable type diagnosing apparatus A, at a step S37 when it is judged that the object service manual data have been received, the service manual data are stored in the RAM 43 and at the next step S38 they are displayed on the display 36. Then the program returns to the step S31.

The service mechanic manipulates the keyboard 37 of the diagnosing apparatus A according to an instruction in the service manual shown in Fig. 7 and performs various diagnoses works such as reading the necessary data in the engine control unit 2, displaying the data on the display 36, checking whether or not the obtained data are proper by comparing them with the criteria of the service manual and inputting measured values to the key board 37.

Thus, in the second embodiment according to the present invention, since the service manual data can be read in a remote place whenever needed, the diagnosis and maintenance works become more convenient and more efficient.

In this embodiment, as an example of the electronic control system installed on the vehicle, the engine control unit 2 has been described, however the electronic control system is not limited to the engine control unit, and for example, other electronic control units such as a transmission control unit, a broke control unit, automatic cruise control unit, an air-conditioner control unit and the like, may be objects of diagnoses.

Further, in this embodiment the service manuals are stored in the host computer, however they may be stored in other external computer forming a computer network.

CLAIMS

1. A diagnostic system for diagnosing the operation of an electronic control circuit on a motor vehicle, said system comprising

diagnostic apparatus,

conductive connecting means connecting the diagnostic apparatus and the electronic control circuit and

an external computer,

said diagnostic apparatus having data reading means for reading data received from the control unit via the conductive connecting means, first data display means for displaying said data and

transmitting means for transmitting data by a wire-less link;

said external computer having means for receiving data transmitted by a wire-less link, data processing means for processing data and outputting data and second data display means for displaying data.

2. The system according to claim 1, further comprising data requiring command inputting means for inputting a data requiring command to said diagnosing apparatus;

first wire-less data transmitting means provided in said diagnosing apparatus for transmitting said command by wire-less link;

second wire-less data receiving means provided in said external computer for receiving said command by wire-less link;

data are service manual data.

7. The system according to claim 2, wherein said service data are service bulletins.

8. The system according to claim 2, wherein said service data are parts lists.

9. The system according to claim 1, wherein said electronic control unit is an engine control unit.

10. The system according to claim 1, wherein said electronic control unit is a transmission control unit.

11. The system according to claim 1, wherein said electronic control unit is a brake control unit.

12. The system according to claim 1, wherein said electronic control unit is an automatic cruise control unit.

13. The system according to claim 2, wherein said electronic control unit is an air conditioner control unit.

14. The system according to claim 2, wherein said data storing medium is a CD-ROM.

15. The system according to claim 2, wherein said data storing medium is an internal memory of said external computer.

said external computer;

receiving said service data by wire-less link; and

displaying said service data on said display of said diagnosing apparatus.

19. A diagnostic system for diagnosing the operation of an electronic control circuit on a motor vehicle substantially as hereinbefore described with reference to the accompanying drawings.